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ON SOME POINTS IN REGARD TO COLOR-  
BLINDNESS.

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IN No. I, vol. viii, of this JOURNAL is an article by Dr. Bannister, with the above heading, which I feel called upon to answer or criticize in some points.

The author says: "If color-blindness of certain kinds and degrees does not disqualify the individual from correctly distinguishing signals, as is claimed by Mr. Wm. Pole, then, the practical importance of the defect is greatly diminished, if not altogether destroyed, as regards these occupations."

Even if we refuse to accept any of the testimony from the experts on the other side of the water, we have a perfect answer to this from the examinations made in this country. From the report of the Board of Health of Connecticut, it will be seen that all persons shown to be color-blind by the worsted test failed in the examination with flags and lanterns, even at the distance the railroad employes and their counsel claimed was fair. I am conversant with Mr. Pole's case, both from the published description

and personal correspondence, and am certain he would fail to distinguish colored railroad and sea signals at distances at which they must be distinguished to render traffic on land and sea safe. I would here refer to the reports of the marine hospital surgeons in the last annual report of the Sup. Surg. Genl. My own experience perfectly coincides with what Holmgren, Donders, and others have said on this point. Donders' apparatus for transmitted light gives us just the condition of colored signals, without extraneous circumstances to help the color-blind to guess by. By it I have never failed to show how dangerous a color-blind was, no matter how little defective he was. The point is just this. There are many so color-blind that they cannot tell red from green signals *close to*, others can distinguish them a little further off, and so on, up to the normal eye's power. A color-blind pilot could not tell *which* light I held up in my office when not ten feet from it. It was said he had never met with accidents. He himself honestly believed he could see the signals as we did, and would never fail. He was perfectly unaware of all the extraneous circumstances which helped him to *guess* which light was before him. In reference to these surroundings, I must, for truth's sake, refer to my manual, and to the Sup. Surg. Genl. Report above mentioned. *But all these helps may fail.* A pilot sees *one* light and has no chance to *compare* the two, which he might distinguish if they were seen together. The pilot of the tug Lumberman failed once, mistaking red for green, and it cost ten lives and much property. The cause of how many more accidents will thus be cleared up, provided the author, as in the case of the Norwalk accident in Connecticut and the Revere accident in Massachusetts, are not beyond the reach of expert testing! This last winter, Prof. Camalt, of Yale, and myself, spent several hours at Washington in proving to the Super-

vising Inspectors of steam-vessels that lanterns were no tests for color-blindness, and that any degree of chromatic defect was dangerous, in spite of the reports of the local inspectors and their examinations. A handsome vote of thanks from the Board proved that our arguments were convincing. When now it is said that those "who may be scientifically color-blind" can see colored signals as well as the normal-eyed, it simply is not true, and EXPERT testing, even with lanterns, will, as in Connecticut and elsewhere, prove it to hasty and even recalcitrant officials. Mr. Pole's remarks were quoted last summer in Connecticut, versus examinations of railroad employes. And so were Mr. Herbert Page's. But since the latter has gone to work in England, with Holmgren's method, he is quite convinced of all I would claim, and has so written me, asking me also to make any use of his letter which may assist the cause of control in this country. The physical impossibility of the color-blind *seeing* as we do, and therefore *believing* as we do, has naturally led them to make many assertions which thorough investigation would contradict, and these have done great harm. I cite Mr. Pole, Prof. Delboeuf as to supposed cure by fuchsine, and I must add Dr. Bannister, for although he prefixes his sentences above quoted with *if*, yet he must remember that all interested pecuniarily or otherwise in opposing laws of control on land or water, will omit this *if* in arguing before committees or officials.

That all this is a pretty practical issue will be admitted, when it is seen that by the rolling up of such apparent evidence the opposers of control can go so far as to say, as does the *Chicago Inter Ocean* of December 17, 1880: "All this being true, the originator of the yarn system ought to be put in jail, and pilots who have suffered ought to bring suit against the government for damages. We say this in all seriousness, and good lawyers inform us that they think damages can be recovered," etc., etc.

The writer says: "Again, if this infirmity is curable by exercise or education, as is held to be the case by Dr. Favre, who was himself one of the first to call attention to the practical points involved, then the whole subject is deserving of far less importance than is nowadays attributed to it."

Here is another *if*, which "good lawyers" will omit when arguing for the consignment to jail of the author of the "yarn system." If the JOURNAL readers will take the trouble, they can find in my manual, by Holmgren, in the *Brit. Med. and Surg. Journ.*, March 28, 1878, and in the monographs and journal articles from all over Europe, overwhelming testimony to the absurdity of the mistake of Dr. Favre in classing as color-blind all boys and girls who failed to *name* colors correctly, and as *cured*, all of those who could be *taught* to call them rightly. I confess to a little surprise, to say the least, at the author thus introducing Favre's ideas, so long ago entirely exploded. I do not think it necessary to say more on this point.

Dr. Bannister says: "If either of these views is correct, it is a reasonable presumption that a person in constant exercise of his perceptive powers in the distinction of colored signals, would be able to overcome or compensate for this particular defect, so far as all practical purposes are concerned, while still, it may be, exhibiting it in the plainest manner to the usual tests. Some facts point very strongly in this direction; the recent examinations of pilots and engineers have revealed cases of color-blindness where it was utterly unsuspected, and in persons who had acceptably filled positions for many years that required daily, and almost hourly, exercise and test of their ability to correctly distinguish colored signals."

This is precisely what makes these men so dangerous, namely, that like the color-blind in other avocations of

every-day life, they escape detection. Now, we have means of readily exhibiting their defect, and of showing how they have caused accidents, the reason of which has hitherto been unexplainable.

It is not any *change* in the color-blinds' chromatic sense which has enabled them to get along as well as they have, but simply the various means necessity has taught them to supplement their want by. As to just what these means are, I must refer again to my manual. They are now quite well understood, and recognized by all examiners. Dalton's color-sense did not alter through life. Many a scientific color-blind, as chemists, etc., have told me how hard they have tried to learn to see colors correctly, but that they were still the same in advanced life. The color-blind cannot see, and, therefore, cannot believe this. In correspondence with the author, I have said that it would, I thought, be possible for a partially color-blind to become educated within his range, as the normal eye becomes educated. Precisely how much this would help him, is very hard to decide, as it is difficult to separate this possible cultivation of his color-sense from the other extraneous helps outside of this sense, which he uses quite unawares to himself. My experience with highly educated color-blind, who needed the chromatic sense for their special studies, and who, therefore, in course of years, would have cultivated the eye all possible, has been that they wholly failed when all the extraneous helps were removed, and they had to decide by the color-perception alone, just as the color-blind pilots reported, failed when all that enabled them to *guess*, was removed. I have never seen any one, even officials, ready to trust their lives, or others, to the color-blind after their defect was perfectly demonstrated to them. It can be readily shown that such a color-blind as Dr. Bannister would be a dangerous pilot or engineer, since he

could not see colored signals quickly enough, or far enough off. In describing his defect, Dr. Bannister says: "The lithium line is a very beautiful and typical red." \* \* \* "I recognize all the spectral colors as distinct in tint, except, perhaps, indigo, which seems only a variety of blue." The casual reader might be misled by this. It must be remembered that the color-blind in any degree cannot, of course, see red and green as the normal-eyed. This is now perfectly proved by the reports of cases of monocular color-blindness. Their use of the same terms or expressions for colors as we do, is no proof of having the same sensations we do. This can very readily be shown by Maxwell's discs. Dr. Bannister cannot see red with the brilliancy we do.

The author says: "It may easily be, and, indeed, it appears highly probable, that a deficient early training, and a lack of special observations of colors in early life, when the cerebral centres are receiving those first impressions that most strongly influence their organization, may have, as their result in adult life, a defect of color-sensibility, varying in degree from scarcely perceptible enfeeblement to pronounced partial color-blindness, or to dyschromatopsia, as in my own case. It may even be that to this, combined with heredity, is due the relatively greater frequency of the defect in the male sex."

We were all, I think, at first inclining to adopt this reasoning, but facts do not support it. Children as young as between three and four years can be readily tested, and their color-blindness detected with certainty. In the case of girls, their education and surroundings would especially tend to develop the color-sense, yet it does not. Mothers have told me how they have worked over their color-blind boys in vain, in endeavoring to teach them to see differently. Others, of course, like Dr. Favre, have made the mistake of supposing that because the color-blind could be

taught to remember the color names of objects, that the color-sense was altered. I do not here refer to the 20 or 30 per cent. of boys whom he called color-blind, because they did not know color-names, and whom he supposed he cured of color-blindness by teaching them these color-names.

Dr. Bannister refers to the mention in my manual "of dulness of color-perception, or rather a peculiar slowness in the colors taking effect." I do not mean by this the retardation of color-perception, "which he describes in his own case, but the slowness to catch colors, which would be helped in the normal eyes by brightening them. For instance, in a poor light or on a dull day, both the girls and boys went through the test less quickly. I had even to take this into consideration in calculating my time at the schools, etc.

The author seems to have misunderstood as to the blind children whom I asked to name the colors of objects. Six were blind from birth, totally so, and only knew by *ear* the color-names of objects. The seventh I said could see somewhat, tell light from dark. This I intended to show by quoting his expression that it was "hard for him to get hold of colors," meaning that he got hold of colors through the eye with difficulty, because he could see so poorly; he was, therefore, not to be classed with the six totally blind from birth.

I must criticize the deductions Dr. Bannister has made from his supposed peculiar chromatic sense or condition, viz.: that by "mental effort" he *can* see colors sooner or later. He says: "The usual test employed in this country for the examination of railway employes and pilots—that of Holmgren—makes, however, no allowance for this variety of color-defect." Dr. Jeffries, the principal authority on this subject in this country, says, in his directions for the use of this test, referring to the colored plate accompanying it: "If

the person examined takes any of the confusion colors ( $\times 5$ ) to put with the green, he proves himself color-blind ; or even if he seems to want to put them together. This rules out all hesitation, and condemns at once as defective any one who exhibits any uncertainty, requiring mental effort or comparison." These directions and explanations are Prof. Holmgren's, and are, of course, to be taken in connection with the very careful and minute description of the tests which he has given, and which I have translated in full in my manual. One great difficulty about the worsted test is that it can only be best learned *de situ*, and when so learned, these directions are quite plain. This same direction was quoted by the Mass. Railroad Commissioners in arguing before the Railroad Committee of the Legislature last year, versus my position of the need of expert examiners. It, of course, gave me a very good opportunity of making a strong point in my favor. The hesitation such a color-blind as Dr. Bannister would exhibit, the expert recognizes as due to color-blindness, and this is the hesitation Holmgren means, as a study of *all* he says, and some personal familiarity with the test will show. There is great difficulty in so describing the test and its application as to be properly understood. He states most distinctly that it can best be learned *de situ*. This is very expensive, as proved by the medical officers of the U. S. government who have studied the use of the test by working with me in our schools, etc.

Dr. Bannister says: "Holmgren's test has the advantage of detecting very slight abnormalities of color-vision, but it also has the defect of exaggerating them." The first part of this is true, and hence the *very great value* of the test. The second part is not the case when it is properly applied, and this is not such a simple thing as it at first seems. Recent letters from Prof. Holmgren admit and



confirm this fully. The worsted test quickly shows such defect as Dr. Bannister reports that he has, and all other tests, as with lanterns, etc., when *properly applied*, will show the danger of this amount of chromatic loss. These so-called "practical tests," which are difficult, consume time, require special apparatus, and open wide the door for collusion and cheating, will only finally, as Surgeon Hutton of the Marine Hospital Service says, "confirm what was decided, within five minutes after commencing the first examination," with the worsteds.

What Dr. Bannister says about the greens and blues in relation to Holmgren's test, would lead me to think that he had not seen it carried out always as it should be. An expert takes no account of the lack of appreciation, from want of training or education, between greens and blues, and also will understand when any such confusion means violet-blindness to be decided by test II with purple. Prof. Holmgren or his adherents can not be responsible for gross mistakes in testing, any more than for the mistake of using the colored plate to examine for color-blindness by, as has been done.

Dr. Bannister says very properly: "When we consider that a man's whole livelihood may depend on the result of the examination, the advisability of avoiding unnecessary mistakes is sufficiently obvious."

As in this country the community is always sacrificed to the individual, we must remember that the slightest source of danger from color-blindness ought to be eliminated, and the lives of a whole steamer or train-load of passengers not be jeopardized for the benefit of a partially color-blind pilot or engineer, who may guess right or may guess wrong.

Again, he says: "Holmgren's should be always carefully supplemented with some other that approaches more nearly

the practical conditions that the color-sense must meet, in cases of incomplete color-blindness. Donders' test with lights seen through colored media in apertures of various sizes, appears to me much more satisfactory for practical purposes than the generally employed one of Holmgren."

This test of Donders' is not to find out whether a person is color-blind,—that Donders' has by Holmgren's or his modification of it,—but to ascertain the *degree* of color-blindness. The great difficulty is that it is not a *comparison* test; we have to ask the examined what he sees, and he has to *name colors*, a source of great danger in testing. Moreover, it will be found that wherever proper laws have been made for testing thoroughly, *control tests*, so-called, are always used besides the worsteds. But time and absolute experience among large numbers of railroad employes have shown the very great value and accuracy of this test of Holmgren's, because wherever a man has been by *proper examiners* shown to be color-blind by it, all the additional or control tests have but confirmed this decision. And, moreover, wherever a man has by proper examiners been shown by Holmgren's test to be in any degree color-blind, he has equally well been shown to be dangerous, in that he could not distinguish quickly and readily, as can the normal-eyed, the necessary colored signals.

Dr. Bannister says, further: "I might discuss here at length the vision of the color-blind, and examine the claim made by Mr. Pole that the red-blind individual, seeing red light as a dark saturated yellow, could yet distinguish it from the green, especially if the blue-green, the complementary color to red, and the tint advised by M. Redard in a recent report to the French government, is used instead of the manifold tints now employed."

An engineer or pilot sees *one* light, not *two*, and has no opportunity for comparison, and no time to stop and *think*

which is before him. The flash of *color* to the normal-eyed is instantaneous, and hence the value of color for signals, and safety in having only normal-eyed in positions where so much depends on their being *felt* "like a slap in the face," as my friend, Prof. Camalt, said in arguing before the Massachusetts Railroad Legislature Committee.

As to Redard's *wholly theoretical* suggestion of the use of bluish-green as opposed to red, experience has shown that it is precisely the bluish-green glass which must be discarded, because all the blue in it breaks down the light to such an extent that, in consequence, two distinct starboard lights are sold on the ships. One of them is deep bluish-green, and it reduces the amount of light so much that the purchaser is pretty sure to return and want it changed. The dealer then replaces it with a pale yellowish-green. This the buyer brings back and says it is mistaken for an ordinary white light, when the change is made again back to the dark bluish-green. After a presentation of these facts, and an exhibition of the several signal glasses before the Board of Supervising Inspectors of Steamboats at Washington, they requested the Secretary of the Treasury to put in the hands of local inspectors *standard* red, green, and white glass, to which all lights on steamers must conform. These standard glasses are now being made, and bluish-green will be particularly avoided. All this applies equally well to the glass for railroad signals. Officials of all kinds have there made the mistake of supposing that a man reported by expert examiners color-blind by the worsted test, was not so or was not dangerous because he could distinguish these *bluish-green* glasses from the red. The red- or green-blind, of course, see blue and yellow as we do. Now a large glass company have lately, of their own accord, thrown aside all these bluish-green glasses, and manufacture at present only pure green, so convinced were they of the danger from

the want of brightness of this dark bluish-green glass. Signal glass for railroads and the ocean should be adapted to the 96 per cent. with normal color-sense, and not to the four per cent. who are more or less color-blind.

The political office-seekers in Connecticut have just repealed the laws controlling color-blindness and visual defects among railroad employes. Massachusetts has just enacted a law of control. Mr. Wm. Pole or Mr. Herbert Page had no idea that their articles could or would be used by Connecticut office-seekers versus proper laws of control urged by the railroad commissioners and passed by the Legislature, and found to be very necessary when carried out. Dr. Bannister's article would have been equally well used, though, no doubt so, opposed to the author's intention. It becomes the duty, not always pleasant, of those trying to obtain legislation, to explain the mistakes or misunderstandings which color-blind writers especially fall into.